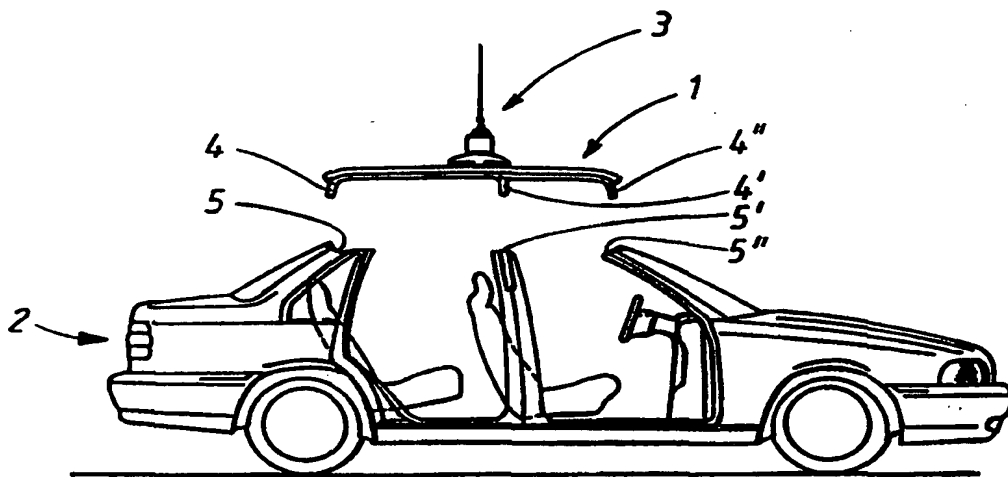


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/SE98/01656 <b>(22) International Filing Date:</b> 16 September 1998 (16.09.98)  <b>(30) Priority Data:</b> 9703341-9                      17 September 1997 (17.09.97)    SE  <b>(71) Applicant (for all designated States except US):</b> AB VOLVO [SE/SE]; S-405 08 Göteborg (SE).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> PERSSON, Arne [SE/SE]; Leverhultsvägen 35-5, S-290 60 Kyrkhult (SE). NYLIN- DER, Åke [SE/SE]; Norra Grinnekärsvägen 26, S-436 56 Hovås (SE).  <b>(74) Agent:</b> GÖTEBORGS PATENTBYRÅ; Sjöporten 4, S-417 64 Göteborg (SE).		<b>(81) Designated States:</b> JP, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i> <i>With amended claims.</i> <i>In English translation (filed in Swedish).</i>

(54) Title: METHOD FOR MOUNTING SELF-SUPPORTING VEHICLE ROOFS



## (57) Abstract

The invention relates to a method for mounting a self-supporting vehicle roof (1) onto a body of a motor vehicle (2). The mounting method according to the invention utilizes a special, self-supporting roof construction of so-called sandwich type, which enables a complete roof (1), comprising both inner roof and outer roof, to be mounted as one of the last components in an assembly line for motor vehicles. After having been mounted, vehicle roofs (1) of the type which is utilized in the method according to the invention will constitute an integrated, load-bearing part of a vehicle body of a motor vehicle.

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**5 Title**

Method for mounting self-supporting vehicle roofs.

**Technical field**

10 The present invention relates to a method for mounting a self-supporting vehicle roof on a body of a motor vehicle.

The mounting method utilizes a special, self-supporting roof construction of so-called sandwich type, which enables a complete roof, comprising both inner and outer roof, to be mounted as one of the last components in an assembly line for motor vehicles. After  
15 having been mounted, vehicle roofs of the type utilized in the mounting method according to the present invention will constitute an integrated, load-bearing part of a vehicle body.

**Background of the invention**

20 Detachable and remountable roofs of for example plastic material, so-called hard-top roofs, are previously known. Such roofs can be mounted in a finished condition as one of the last components in an assembly line for motor vehicles, but are not intended to constitute a load-bearing part of the body of a motor vehicle to any great extent. Accordingly, in order to compensate for this, the body and/or the chassis of vehicles of this type has/have to be provided with additional reinforcements.

25 Furthermore, so-called folding tops, i.e. upwardly and downwardly foldable vehicle roofs of different textile and/or plastic materials for use in for example convertible cars, are previously known.

30 Where folding tops are concerned, it is conceivable to mount a folding top in a finished condition comparatively late along the assembly line. A folding top, however, does not constitute a load-bearing component in the body of the vehicle. Therefore, convertible cars also have to be provided with additional reinforcements in a similar way as when vehicles having hard-top roofs are concerned.

In conventional motor vehicles, the most common roof type is sheet-metal roofs which comprise an outer roof of sheet-metal and a post-mounted inner roof, providing insulation and decoration. This type of conventional vehicle roof constitutes an integrated, load-bearing part of the body of a motor vehicle.

When manufacturing the outer roof portion of such conventional, self-supporting vehicle roofs of sheet-metal, different metal working operations are usually used, such as pressing, rolling and welding. When the outer roof portion has been mounted onto the vehicle body or has been moulded together therewith, the outer roof is provided in one or several steps with possible insulating and decorative layers on the side which is to constitute the inner roof facing towards the passenger compartment. The mounting of the separate inner roof normally takes place as one of the last steps in an assembly line for motor vehicles.

Vehicle roofs of different plastic composites or laminates are also known. After having been mounted, such previously known vehicle roofs can certainly constitute an integrated, load-bearing part of the body of a motor vehicle. In a similar way as when sheet-metal roofs are concerned, the previously known vehicle roofs of composite or laminate type, however, require that a separate inner roof is mounted at the end of the assembly line.

Because of the limited working space, post-mounting of a separate inner roof can be perceived as relatively difficult and ergonomically uncomfortable, and also consumes important assembly time.

There is also a certain risk that interior components, which have been mounted earlier in the assembly line, are damaged or soiled during the subsequent mounting of the inner roof.

### **Summary of the invention**

Accordingly, an object of the present invention is to provide an ergonomically advantageous and simple method for mounting a self-supporting vehicle roof, which is complete with outer and inner roof, and which is intended to constitute an integrated, load-bearing part of the body of a motor vehicle after having been mounted.

In accordance with claim 1, this object of the invention is achieved by means of the self-supporting vehicle roof comprising an outer roof and an inner roof before mounting onto a roof-less vehicle body of a motor vehicle starts, and that thereby the self-supporting roof comprises a number of first mounting points, while said roof-less vehicle body comprises  
5 a number of second mounting points, and that first and second mounting points are joined together in pairs in order to create stable joints and thereby to provide a vehicle body of a motor vehicle in which the self-supporting roof constitutes an integrated, load-bearing part.

#### 10 **Brief description of the drawings**

In the following, the invention will be described in greater detail with reference to the attached drawings, in which

Fig. 1A schematically shows a motor vehicle, the body of which is roof-less, and a self-supporting vehicle roof being lowered towards the vehicle body in order to be  
15 mounted,

Fig. 1B schematically shows the motor vehicle in Fig. 1A during mounting and fixation of the lowered vehicle roof, and

20 Fig. 1C schematically shows a completely assembled motor vehicle onto which a self-supporting vehicle roof has been mounted by means of the method according to the invention.

#### 25 **Detailed description of preferred embodiments**

In the attached Fig. 1A, a vehicle roof is shown while being lowered in a direction towards a vehicle body of an almost completely assembled motor vehicle. Thereby, the vehicle roof utilized in the method according to the invention is a complete, self-supporting vehicle roof, with both outer and inner roof, and intended to constitute an integrated, load-bearing  
30 part of the structure after having been mounted.

In the following, a suitable material structure for the vehicle roof which is utilized in the method according to the invention will be proposed.

5 Such a suitable material structure comprises a material structure of so-called sandwich type, which provides sufficient stiffness and strength in order to be able to constitute an integrated, load-bearing component of the body of the motor vehicle after having been mounted.

10 From the outside and inwards when the vehicle roof is mounted onto a motor vehicle, a suitable material structure of a vehicle roof for use in the method according to the invention comprises an outer cover layer, a core, an inner cover layer, an insulating layer and a decorative layer.

15 The outer cover layer provides an attractive (uniform and lustrous) surface finish on the side which is facing outwards (upwards in Fig. 1A), because the outer cover layer after mounting will be facing towards the exterior side of the vehicle and has to provide a visually attractive and protective surface, which also must be possible to paint or varnish with good results when this is desirable or necessary. The outer cover layer can, for example, consist of so-called laminate sheet with two external layers of 0.2 mm aluminium  
20 foil enclosing an intermediate layer of 0.8 mm polypropylene film.

The main task of the core is to provide high bearing resistance and low weight per unit volume, i.e. low density. Furthermore, the core contributes to the sound and heat insulating ability of the vehicle roof. The core can, for example, consist of a 10 mm thick layer of  
25 polymetachrylimide foam, which is attached to the above-mentioned outer cover layer with for example epoxy-glue of two-component type.

The main function of the inner cover layer, situated inside the core, is to provide high strength. The inner cover layer, together with the above-mentioned outer cover layer and  
30 the core should, namely, provide the above-mentioned sandwich structure with high stiffness and low weight, in order to give the vehicle roof according to the invention suitable properties for the application. The inner cover layer can, for example, consist of

a glass-fibre reinforced polypropylene plastic sheet with 0.6 mm thickness and can, for example, be attached to the core by means of thermal bonds originating from the thermoplastic polypropylene.

5 Conjointly, the insulating and the decorative layers constitute a unit which in function can be said to correspond to a conventional inner roof of a vehicle. The insulating layer provides sound and heat insulating properties and a certain softness, whereas the primary task of the decorative layer is to provide a decorative interior surface, intended to be visible from within the passenger compartment.

10

The insulating layer can, for example, consist of a polyether foam layer with open cells and approximately 4.0 mm layer thickness, while the decorative layer for example can be constituted of a knitted polyester textile.

15

Such a material structure, suitable for use in a vehicle roof which is to be utilized in a method according to the invention, can be manufactured by means of laminating and heat pressing or moulding methods known per se.

20

According to a particularly preferred embodiment of the invention, the above-mentioned outer cover layer provides exterior surfaces with a sufficient surface finish, already when the self-supporting vehicle roof is mounted, in order to require only a light polishing operation before the motor vehicle is transported from the assembly operation and proceeds further to sales. Such a polishing operation can be performed with suitable previously known techniques for the purpose in connection with other exterior body parts being polished.

25

As mentioned above, the vehicle roof for use in the method according to the invention can also be surface finished, painted or varnished with suitable previously known techniques, when this is necessary and desirable.

30

Furthermore, the vehicle roof which is to be utilized in the method according to the invention is provided with a number of first mounting points according to previously known technique.

5 These first mounting points 4, 4', 4" are schematically depicted in the attached Fig. 1A and are intended to be joined to a corresponding number of second mounting points 5, 5', 5" on the remaining portion of a roof-less vehicle body of a motor vehicle which is being assembled.

10 The first mounting points 4, 4', 4" can, for example, be constituted of reinforcements or protruding tabs for screw or bolt joints inserted into the plastic material, or of surfaces which are prepared for gluing. The corresponding second mounting points 5, 5', 5" of the vehicle body, preferably situated in the roof pillars, can be of the same type as in the first mounting points 4, 4', 4" of the vehicle roof, or of another suitable type according to  
15 previously known technique.

Accordingly, in the method according to the invention, a self-supporting vehicle roof of the type previously described herein is placed onto the body of a motor vehicle 2 missing a vehicle roof. In the described embodiment, this is done in the way shown in Fig. 1A, with  
20 the aid of lifting gear according to previously known technique.

When the vehicle roof 1 has been placed in the correct position on the vehicle body, so that the positions of the above-mentioned first 4, 4', 4" and second mounting points 5, 5', 5" correspond to each other in pairs, said number of first and second mounting points are  
25 fixated to each other so that stable joints are created. As is evident from above, this can for example be done by means of bolt or screw joints which join first mounting points of the vehicle roof to corresponding second mounting points of the remaining body.

Where glue joints are concerned, a glue which is suitable for the purpose has of course to  
30 be applied on all first and/or second mounting points before the vehicle roof is placed in its final position. The glue can be of any suitable previously known type, as is also the case with the application method.



It is also conceivable to use other types of mounting points or joints than those mentioned herein, as long as joints with a sufficiently high strength and permanence can be obtained between the vehicle roof and the remaining vehicle body. Examples of such alternative joining techniques are welding, plastic application and thermoplastic joints. In this respect, thermoplastic joints refers to all types of joints comprising a thermoplastic layer or material, by means of being heated above the softening temperature, that is brought into an adhesive state in order to create a joint after cooling in which the cohesive force is thermal bonds.

10 When the fitter, schematically depicted in Fig. 1B, has finalized the joining of first 4, 4', 4" and second mounting points 5, 5', 5" together in pairs, an almost completely assembled vehicle body with a self-supporting vehicle roof complete with outer and inner roof is obtained.

15 The mounted, self-supporting vehicle roof constitutes an integrated, load-bearing part of the body of a completely assembled motor vehicle 2".

The method according to the invention provides an ergonomically advantageous and simple method for mounting a load-bearing vehicle roof onto a motor vehicle and, furthermore, enables the majority of all interior components to be finally mounted in the vehicle before the mounting of the self-supporting vehicle roof takes place. This also provides advantages with improved ergonomics and space in the assembly steps which precede the mounting of the vehicle roof.

25 The present invention is by no means limited to what has been described in connection with the preferred embodiments or to what is shown in the attached drawings, and the scope of the invention is defined by the appended claims.

Accordingly, it is conceivable with embodiments of the method according to the invention wherein one or several steps are automated in order to be performed semi-automatically or automatically, using for example a robotic device.

Furthermore, a number of different material structures are conceivable in the vehicle roof utilized in the method, as long as the vehicle roof can fulfil the demands on for example load-bearing ability and low weight which is required by the application, and as long as the vehicle roof is provided in a complete form with outer roof and inner roof before being mounted.

**Claims**

5

1. A method for mounting a self-supporting vehicle roof, characterized in that the self-supporting vehicle roof (1) comprises an outer roof and an inner roof before mounting onto a roof-less vehicle body of a motor vehicle (2) starts, and that said self-supporting roof (1) comprises a number of first mounting points (4, 4', 4''), while said roof-less vehicle body comprises a number of second mounting points (5, 5', 5''), and that said first (4, 4', 4'') and second mounting points (5, 5', 5'') are joined together in pairs in order to create stable joints and thereby to provide a vehicle body of a motor vehicle (2'), in which said self-supporting vehicle roof (1) constitutes an integrated, load-bearing part.

15

2. A mounting method according to claim 1, characterized in that the self-supporting vehicle roof (1) is mounted onto the vehicle body in the final section of an assembly line for motor vehicles when the majority of the interior components of the motor vehicle already have been mounted.

20

3. A mounting method according to claim 1 or 2, characterized in that the first (4, 4', 4'') and second (5, 5', 5'') mounting points are joined together in pairs by means of any one or a combination of several of the following methods; gluing, welding, screwing, bolt joining, plastic application and thermoplastic joining.

25

4. A mounting method according to any one of the preceding claims, characterized in that the self-supporting vehicle roof (1) when being mounted comprises an outer cover layer, a core, an inner cover layer, an insulating layer and a decorative layer, and that the inner cover layer together with the outer cover layer and the core thereby provide a sandwich structure with high stiffness and low weight, whereas the insulating layer provides sound and heat insulating properties and softness, and the decorative layer provides a decorative interior surface which is intended to be visible from within a passenger compartment of the motor vehicle (2, 2', 2'').

30

5. A method according to any one of the preceding claims,  
c h a r a c t e r i z e d i n that the outer cover layer, when the self-supporting vehicle roof  
(1) is mounted, provides external surfaces of said vehicle roof (1) with a surface finish  
5 allowing the completely assembled motor vehicle (2") to proceed directly to sales after a  
conventional polishing operation.

**AMENDED CLAIMS**

[received by the International Bureau on 11 February 1999 (11.02.99);  
original claim 1 amended; remaining claims unchanged (1 page)]

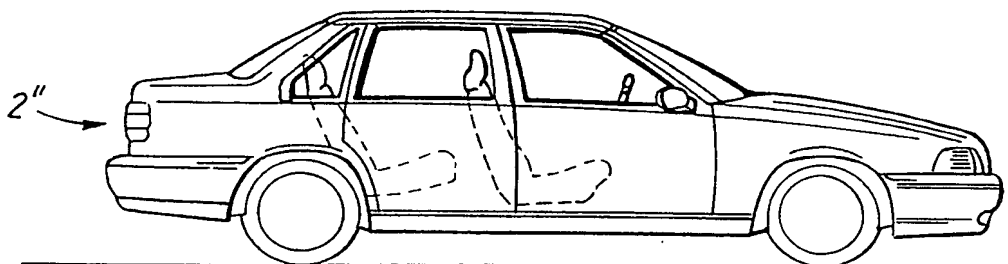
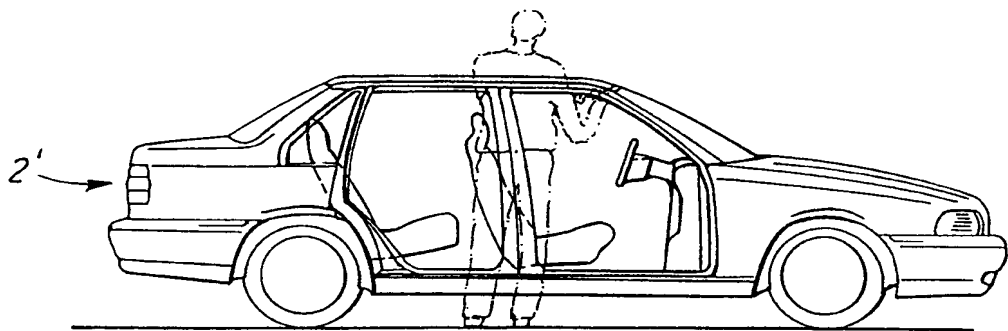
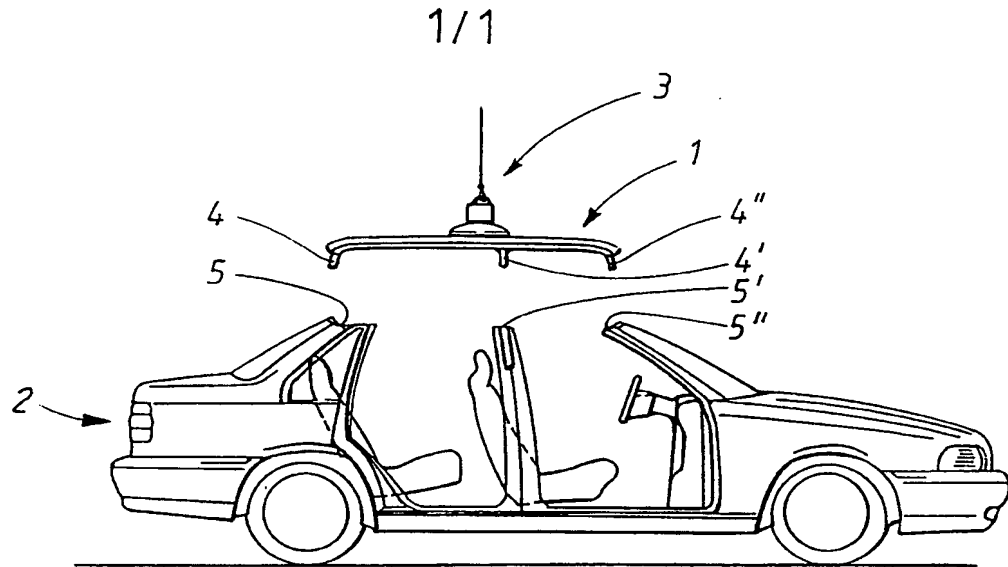
5

1. A method for mounting a self-supporting vehicle roof,  
wherein said self-supporting vehicle roof (1) comprises a number of first mounting points  
(4, 4', 4''), while a roof-less vehicle body comprises a number of second mounting points  
(5, 5', 5''), and said first (4, 4', 4'') and second mounting points (5, 5', 5'') are joined together  
10 in pairs in order to create stable joints and thereby to provide a vehicle body of a motor  
vehicle (2'), in which said self-supporting vehicle roof (1) constitutes an integrated, load-  
bearing part, characterized in that the self-supporting vehicle roof (1) is provided  
in a complete form having an outer roof and an inner roof before mounting onto the roof-  
less vehicle body of the motor vehicle (2) starts, wherein an insulating layer and a  
15 decorative layer correspond to said inner roof.

2. A mounting method according to claim 1,  
characterized in that the self-supporting vehicle roof (1) is mounted onto the  
vehicle body in the final section of an assembly line for motor vehicles when the majority  
20 of the interior components of the motor vehicle already have been mounted.

3. A mounting method according to claim 1 or 2,  
characterized in that the first (4, 4', 4'') and second (5, 5', 5'') mounting points are  
joined together in pairs by means of any one or a combination of several of the following  
25 methods; gluing, welding, screwing, bolt joining, plastic application and thermoplastic  
joining.

4. A mounting method according to any one of the preceding claims,  
characterized in that the self-supporting vehicle roof (1) when being mounted  
30 comprises an outer cover layer, a core, an inner cover layer, said insulating layer and  
decorative layer, and that the inner cover layer together with the outer cover layer and the  
core thereby provide a sandwich structure with high stiffness and low weight, whereas the  
insulating layer provides sound and heat insulating properties and softness, and the



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 98/01656

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B62D 29/04, B62D 25/06, B62D 65/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B62D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EDOC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0250678 A1 (LAMB-SCEPTRE DESIGN CENTRE LIMITED), 7 January 1988 (07.01.88), page 4, line 48 - line 54; page 5, line 40 - page 6, line 4, figures 1-16, abstract	1-3
Y	figures 1-16, abstract --	4,5
Y	GB 2115753 A (FORD MOTOR COMPANY LIMITED), 14 Sept 1983 (14.09.83), page 1, column 1, line 50 - column 1, line 63; page 1, column 2, line 95 - column 2, line 114; page 1, column 2, line 126 - page 2, column 1, line 5, figures 3,4, abstract	4,5
A	--	1-3

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Date of the actual completion of the international search

8 December 1998

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 98/01656

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2211798 A (HONDA GIKEN KOGYO KABUSHIKI KAISHA), 12 July 1989 (12.07.89), figures 4-6, abstract  --	1-5
A	US 4978164 A (NAKAMURA ET AL), 18 December 1990 (18.12.90), figure 1  --	1-5
A	DE 2929689 A1 (VOLSWAGENWERK AG), 12 February 1981 (12.02.81), figures 1,8  -- -----	1-5



# INTERNATIONAL SEARCH REPORT

Information on patent family members

03/11/98

International application No.

PCT/SE 98/01656

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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DE 2929689 A1	12/02/81	NONE	

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